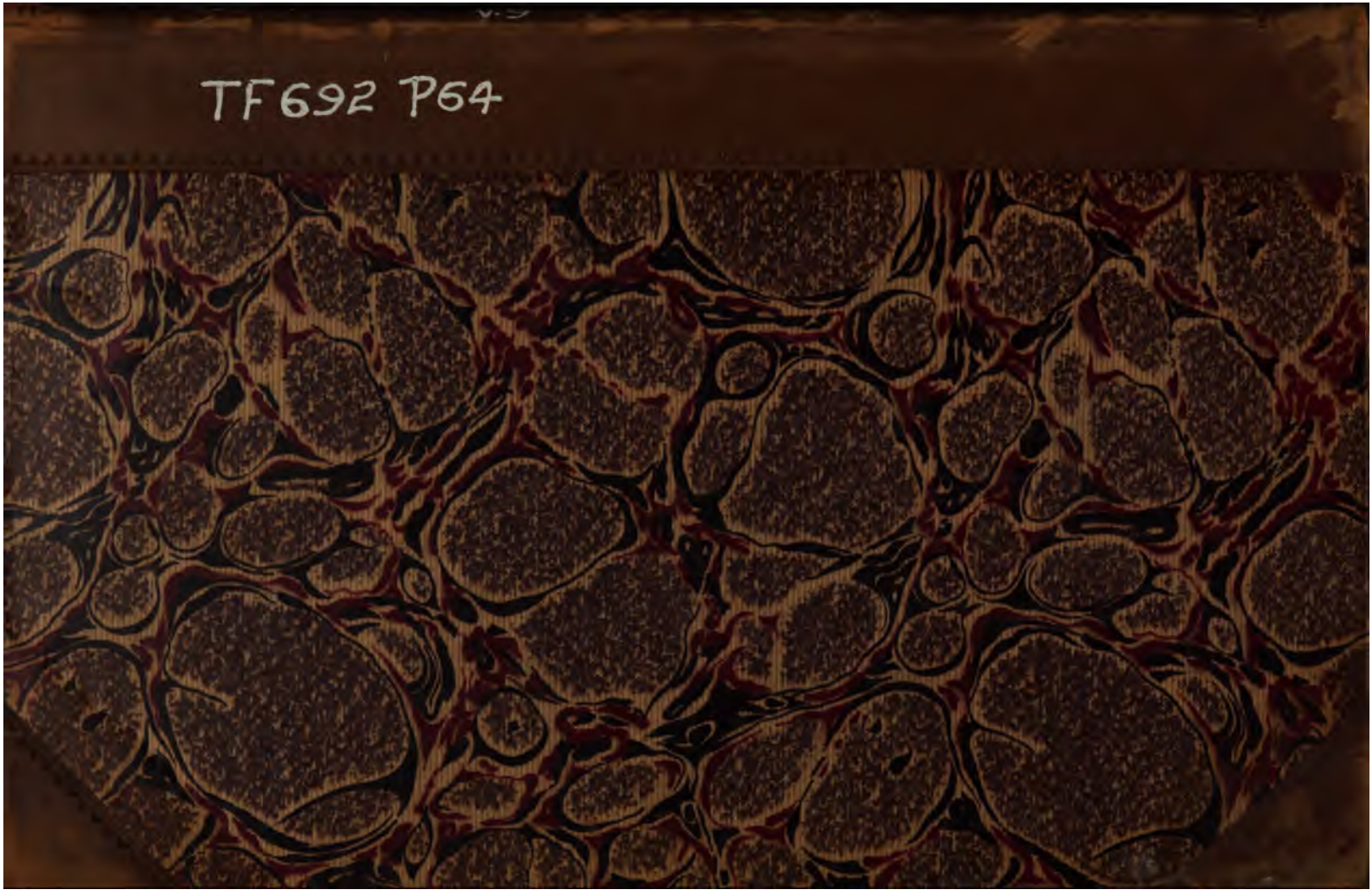

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Pim's Letter to Lord Morpeth., 1841.

Do. to Earl of Ripon June 24, 1842. Second Edition.

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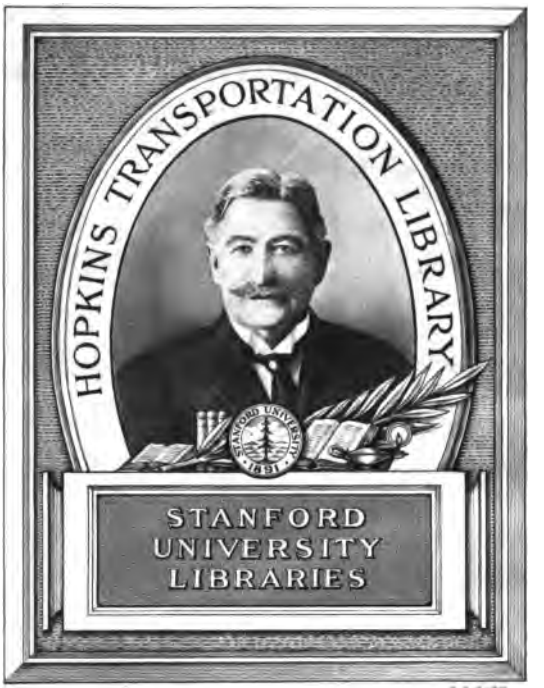
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IRISH RAILWAYS.

THE ATMOSPHERIC RAILWAY.

A LETTER

TO THE

RIGHT HON. LORD VISCOUNT MORPETH,

BY

JAMES PIM, JUN.,

TREASURER OF THE DUBLIN AND KINGSTOWN RAILWAY COMPANY.

LONDON:

PRINTED BY J. L. COX & SONS, GREAT QUEEN STREET,

LINCOLN'S-INN FIELDS.

1841.

A LETTER,

&c.

My Lord,

Observing that the House of Commons has granted your Lordship leave to bring in a bill, which I trust may lead to the introduction of a general and comprehensive system of Railways into Ireland, under the control and direction of the state, I am induced to submit a few observations directly connected with the practical operations contemplated under the proposed measure.

I believe it will be generally admitted by all who have paid attention to the subject, that for any probable amount of traffic, whether of goods or passengers, which can arise in Ireland for very many years to come, *single* lines of Railway would be found amply sufficient. Now by providing for a single line only, the cost of construction will be most materially diminished. In cuttings, embankments, and purchasing of

land, the saving will be nearly proportionate to the lesser breadth required. In ballasting, rails, sleepers, and all upper works, it will be fully one-half; and in tunnels, bridges over the line, and such works, the saving would be considerable; probably it would not be too much to assert, that 60 miles of single railway would not cost more than 40 miles of double line. And should a few years show such an increase of traffic as to demand a second line, I am well advised it could then be added for less money than the cost of the first.

But *single* lines of Railway cannot be worked by locomotive power to their full extent, without incurring danger from collisions, the consequences of which are of a fearful character, so much so as to render their adoption highly questionable.

If these premises be admitted, it becomes an object of the utmost importance, to ascertain if there be any other means of working a *single* line of Railway, economically and effectually, without incurring the risks which I have assumed to be attendant on the locomotive system, when applied to a *single* line.

It is very generally known that several ingenious persons have, from time to time, proposed to employ the pressure of the atmosphere as an element of locomotive power, and the names of

Papin, Lewis, Vallance, Medhurst, and Pinkus, will be familiar to those who are interested in the subject.

Some of their speculations are so curious, that I may be pardoned for trespassing on your Lordship's time in alluding to them.

Mr. Vallance, who obtained a patent in 1824, proposed to construct hollow cylinders of cast-iron, sufficiently large to allow carriages with passengers and goods to pass through them; a series of these cylinders are to be united, and extend from to town, the junctions being made sufficiently air-tight to allow of a vacuum being produced within; and the carriages, formed to the figure and dimensions of the cylindrical trunk, are to be projected from place to place by the pressure of the atmosphere rushing forward to supply the vacuum.

It is needless to go further into the details, the specification of which, we are told, occupies sixteen and a half closely written skins of parchment. I shall only mention, that the speed which appears to have been calculated on for ordinary occasions, was about 200 miles per hour; but which, Mr. Vallance says, "*could not be conveniently carried beyond one thousand miles per hour, as that is the rate of velocity with which air rushes into a vacuum.*"

Mr. Medhurst's plan was nearly similar; he

proposed to construct a hollow tube or archway of iron, brick, timber, or any material that will confine the air, and of such dimensions as to admit a four-wheeled carriage to run through it. The tube or aerial canal must be made air-tight, and of the same form and dimensions throughout, having a pair of cast-iron or stone-wheel tracks, securely laid all along the bottom, for the wheels of the carriage to run upon; and the carriage must be nearly of the size and form of the canal, so as to prevent any considerable quantity of air from passing by it.

Mr. Medhurst then proposed to *drive* a quantity of air by a powerful engine behind the carriage, and impel it forward by this means. Its return was to be accomplished by the converse of this process. His expectations of velocity appear to have been on a much more modest scale than his predecessor Mr. Vallance.

Mr. Medhurst, however, seems to have some misgivings that his passengers might not like to be confined in the piston of an air-pump, for such his carriage would really become. And he suggested a singularly ingenious means of forming a communication between the air-pump and an *external* carriage, by means of a water valve; and by this means, he says, "to impel a carriage along upon an iron road, in the open air, with equal velocity, and in a great degree possessing

the same advantages as in passing withinside of the tube, *with the additional satisfaction to passengers of being unconfined and in view of the country.*" It unfortunately happened that this water valve required to be laid accurately level throughout its entire length, and of course could not be practically applied.

Mr. Pinkus appears to have done little more than to suggest a new form of valve, which I am not aware has led to any practical result.

It is not to be wondered at, that with such statements before us, any proposal to adopt an atmospheric or pneumatic Railway should be received with ridicule or with pity; and so great has been the prejudice against it, that very few indeed, even among those who are most interested in Railways, have taken the trouble of ascertaining what has been accomplished by Messrs. Clegg and Samuda, although their invention has been publicly exhibited for nearly twelve months within three miles of Oxford-street.

The apparatus constructed by those gentlemen appears to be based on the suggestion of Mr. Medhurst, but instead of the impracticable water valve, they have adopted one which is at the same time simple and efficacious.

It would be a most ungracious trespass on your Lordship's time, were I to attempt any

minute description of this apparatus. To those who feel an interest in such matters, I would respectfully recommend them to go and see. I have repeatedly gone, and most carefully examined all their arrangements; and although the scale upon which their experiments have been tried may be thought scarcely sufficient to arrive at an absolute demonstration by those who only view it superficially, every successive visit has tended to increase the conviction to which I have now arrived, that their invention is *economically* applicable to every existing Railway at present worked by locomotive power.

If this position be correct, and I give it deliberately, and after much consideration, it necessarily follows, that the advantages will be much greater where the lines have originally been laid out, with the view to the application of this novel principle.

It is not necessary that the gradients should be so perfect, as on those lines where the locomotive has to overcome the maximum amount of resistance; in this alone, the saving in cost of construction may be very considerable.

The curves may be of much shorter radius than on ordinary Railways, and this also tends to lessen the original cost.

The tops of the carriages need not be more

than eight feet from the surface of the rails; here again arises a great saving in the cost of bridges, tunnels, &c.

The Locomotive being dispensed with, the weight of the rails may be reduced to less than one-half that which is now generally adopted; the chairs, and all the other "upper works" of the Railway, may be reduced in nearly a similar proportion; and for the gigantic viaducts which now span our valleys, very light and comparatively inexpensive structures may be safely substituted; every description of carriage may be made lighter, and its cost diminished.

If I am at all right as regards expenses of *construction*, it will be readily conceded that those of *maintenance* will be lessened at least in an equal proportion. The destructive action of the Locomotive being withdrawn from the road, a comparatively small sum will keep it in repair.

But the greatest saving will probably be found in the cost of *working*. Fixed engines, consuming coal or turf, as the case may be, will provide power at a much less cost than locomotives under the most favourable circumstances; but where the latter have to be supplied with coke in remote districts in Ireland, the difference would be enormous. The wear and tear of a Locomotive, as compared with a fixed engine, has been stated as 18 to 1; I believe it to be in

a much higher ratio: and under judicious management, there may be a vast amount of spare power let out to the public for many useful purposes, every three miles of the road; and it may be remarked that water power, where it can be obtained, will be equally applicable as steam.

In addition to all these economical advantages, the personal comfort of all parties would be much increased by the adoption of this new mode of transit; the trains would be almost noiseless, and free from the smell, the dust, and the sparks from the engine; but, above all, every apprehension of danger would be removed; *collision is physically impossible;* it is almost impossible for one train to run into another; and it is highly improbable that a train can get off the rails when the impelling force must always be in the right direction, and where the leading carriage is fastened down to the atmospheric apparatus.

But it is not merely in Ireland that *single* lines of Railway are applicable, they are equally so in all directions where the traffic is not enormous, and their introduction into Wales,—Cornwall, and Devon,—for the communication between the North of England and Scotland, and through other remote or unproductive districts, may depend upon the success of the Atmospheric Railway.

Again, the speed which may be attained by

this mode is greater than by the locomotive. I have travelled along the experimental apparatus at Wormwood Scrubs at the rate of more than 40 miles per hour, and I see no difficulty in having the mails and light trains conveyed, with the most perfect safety, at the rate of 60 miles per hour.

But it may be fairly asked, if this invention possesses all the advantages I have enumerated, how has it happened that it has not yet been adopted by any of the enterprising parties engaged in Railway speculations in England ?

The answer is not difficult : in the first place, from the causes I have already set forth, there has been so much prejudice excited, that few are aware of what has been accomplished. An experimental apparatus, in the hands, and under the sole management of the patentees, will never satisfy the public ; the scale has been too small to produce conviction that it is applicable to longer lines, to greater loads, and to continued operation ; many will say, "it's all very well for half a mile, but it will never do in practice."

Again, no railway at full work could even make a trial of it, without most materially interfering with their existing traffic ; and even if this difficulty were removed, it may be doubted whether the funds of any company could with strict legal

propriety be appropriated to the purpose of trying such an experiment. It must also be admitted, that it is unreasonable to expect that those who are so deeply interested in the existing system of railways, whether as capitalists or engineers, should feel any very anxious desire to demonstrate the capabilities of the new system, which may by possibility prove a most formidable rival.

How, then, is it possible to ascertain if this invention be such as I have described it, and as I fully believe it to be : or whether some unforeseen difficulty may not arise on a much larger scale, with continued practical operations going on, which shall disappoint all our expectations ?

There is at the present moment a singularly favourable combination of circumstances, which would enable parties to test this invention in the most satisfactory manner, and at the least possible cost and risk.

The works at Kingstown Harbour are so far completed, that one line of the tram road in the possession of the Commissioners has been long since disused. This road leads from the terminus of the Dublin and Kingstown Railway to the village of Dalkey ; it is $1\frac{3}{4}$ miles long, its average inclination is 1 in 120, and it presents curves of less than a quarter of a mile radius,

thus offering in this short length rather formidable difficulties.

The road being already prepared, a very moderate sum would suffice to lay down a line of light rails, and provide the Atmospheric apparatus with a steam engine of suitable power. Having gone carefully into the details, I am enabled to state that the entire outlay need not exceed £15,000, and that even if the experiment should prove an utter failure, the *loss* will not exceed one-half that sum.

If Railways are to be introduced into Ireland on any comprehensive plan, whether under the control and direction of the state, or by means of private enterprise, or by the measure at present contemplated, or by any combination or modification of all or either of these plans, surely it would be but prudent to make some exertion to ascertain the truth, where such an enormous interest is at stake, and when the expense, as compared with the object, is utterly trivial.

The situation in question affords every possible facility for trying the experiment fully and economically; its terminus being immediately adjoining that of the Dublin and Kingstown Railway, a vast number of their passengers and others would be induced to visit the beautiful sea coast scenery beyond Dalkey, and particularly when they would be also attracted by

the novel and delightful mode of transit; so that we may fairly assume that a much greater number of passengers would pass over it at times than are now conveyed by the great lines of English Railways.

To accomplish this object, however, the permission of Government must be obtained to erect the necessary works at the cost of those who may be disposed to take an interest in this most important experiment, and it would probably be desirable that the trial should be made under the superintendence of the Board of Public Works for Ireland, under whose care the tram road I have mentioned is now placed.

Should there be found those who would require a more extended trial, on a longer line, the Dublin and Kingstown Railway is at hand; and if the new mode be found equal to its traffic, and at the same time economical, of its complete success everywhere, there can be no doubt.

It is only right that I should warn your Lordship, that if this experiment shall be tried in the way I have suggested, it will bring a very considerable influx of passengers to the Dublin and Kingstown Railway; and there are, no doubt, very many charitable persons, who will believe that the zeal I have shown in the cause of the one, has been stimulated by the pecuniary and personal interest I have in the other. I give them

most cheerfully the full value of their objection, and I trust it will induce them to examine more carefully those statements and deductions which I now beg most respectfully to submit to your Lordship's consideration.

I have the honour to be,

My Lord,

Your obliged and faithful servant,

JAMES PIM, JUN.

LONDON:
Printed by J. L. Cox and Sons, 75, Great Queen Street,
Lincoln's-Inn Fields.

THE

ATMOSPHERIC RAILWAY.

A LETTER

TO THE

RIGHT HON. THE EARL OF RIPON,

PRESIDENT OF THE BOARD OF TRADE,

&c. &c. &c.

By JAMES PIM, M.R.I.A.

TREASURER OF THE DUBLIN AND KINGSTOWN RAILWAY COMPANY.

WITH PLATES.

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PRINTED BY NUTTALL AND HODGSON, GOUGH SQUARE,
FLEET STREET.

TO THE RIGHT HONOURABLE

THE EARL OF RIPON,

PRESIDENT OF THE BOARD OF TRADE,

&c, &c. &c.

My Lord,

I beg leave, through the medium of your Lordship, to submit to the consideration of the Lords of the Committee of Privy Council for Trade, the following communication respecting the system of Locomotion on Railways, by means of the pressure of the atmosphere, which the inventors have called "*The Atmospheric Railway.*"

The institution of a special department of the Board of Trade for the surveillance, and, to a certain extent, for the control of Railways, will, I hope, be considered sufficient justification for trespassing on their Lordships.

If the proposal I am about to submit had no further object than to lessen the present expenses in the construction, maintenance, and working of Railways, I would respectfully urge that it is well entitled to the attention

of your Lordship; since, to use the words of an enlightened and intelligent writer on these subjects, "In all countries, and under all circumstances, it is an object worthy of a statesman, to prevent a waste of the national means, and to give a right direction to the public expenditure." If, in addition to economy, the proposal went to obtain considerably greater speed of travelling, with increased comfort to the passengers, it would have still stronger claims to favourable consideration; but if, besides these advantages, it is proposed to remove from the Railway system almost all its liability to accident, and to confer on it almost absolute exemption from danger, combining in itself all the great desiderata of Railway transit, safety and comfort being closely bound up with economy and expedition, I have no hesitation in claiming that it is entitled to rank with the most important inventions of the present age, and I am confident it will not fail to obtain, from your Lordship and the Board of Trade, the attention and inquiry it deserves at your hands, *as conservators of the public safety.*

This claim is not made lightly, nor without a suitable feeling of responsibility; it has resulted from a careful and prolonged investigation, and from repeated experiments, in which I have been assisted by many of the most distinguished

men of science, and by several eminent practical engineers; whose concurrent opinions have led me to such a perfect conviction of the importance of the subject, as to induce this application to your Lordship.

I will commence my statement with a concise description of the means by which the objects I have enumerated are obtained; and will then state, in some degree of detail, the advantages offered by the proposed plan, which will necessarily lead to some comparison with the present system; and I shall beg to ask your Lordship's kind attention to the suggestion I shall, in conclusion, venture to offer, as the means of obtaining some useful result.

It is very generally known that several ingenious persons have, from time to time, proposed to employ the pressure of the atmosphere, as an element of Locomotive power; but their speculations and suggestions were so far removed from practical efficiency, that proposals to adopt an Atmospheric or Pneumatic Railway have hitherto been received with contempt or ridicule; indeed, so great has been the prejudice against the principle, that very few, even among those most interested in Railways, have taken the trouble of investigating what has been accomplished by the very simple and complete apparatus constructed by Messrs. Clegg and Samuda,

whose invention has been publicly exhibited on the West London Railway, at Wormwood Scrubs, for nearly eighteen months past.

Although the scale upon which these experiments have been tried, may be thought scarcely sufficient to arrive at an absolute demonstration, by those who only view it superficially, every successive visit has tended to confirm the conviction, in the minds of those best qualified to decide, that the invention combines the great essentials of *economy*, *expedition*, and, above all, of *safety*.

On this system of working Railways, the moving power is communicated to the trains by means of a continuous pipe or main, of suitable diameter, laid in the middle of the track, and supported by the same cross-sleepers, to which the chairs and rails are attached; the internal surface of the pipe being properly prepared by a coating of tallow, a travelling piston, made air-tight by leather packing, is introduced therein, and is connected to the leading carriage of each train by an iron plate or coulter. In this position, if part of the air be withdrawn from that length of pipe in front of the piston, by an air-pump, worked from a stationary engine or by other mechanical means, placed at a suitable distance, a certain amount of pressure on the back of the piston (being the Locomotive force)

will take place, proportioned to the power employed; in practice, and to work economically, it will be sufficient to produce an exhaustion of air in the pipe, equal to causing a pressure from the atmosphere, upon or behind the travelling piston, of 8lbs. per square inch, which is only about one half the pressure due to a vacuum. Supposing the main pipe to be of eighteen inches internal diameter, it will receive a piston of 254 superficial inches area, on which, with the above pressure, a tractive force of 2,032lbs. is consequently obtained; and this is capable of propelling a train weighing 45 tons (or eight to nine loaded carriages), at the rate of 30 miles an hour, up an acclivity of 1 in 100, or 53 feet per mile.

The iron coulter being fixed to the travelling piston within the pipe, and also to the leading carriage of the train, connects them together, moving through an aperture formed in the top, and along the whole length of the pipe; while one set of vertical rollers attached to the piston-rod, at some little distance beyond the piston, progressively lift up for the space of a few feet, and another set of rollers, attached to the carriage, close down again, a portion of a continuous flexible valve or flap, of peculiar construction, covering the aperture; and it is the very simple, ingenious, and efficient mode of successively

opening, and closing down and hermetically sealing this valve, as each train advances and moves on, that constitutes the merit of the invention, and the foundation of the patent; the operation consisting first, in opening the valve to admit the free admission of the external air, to press on the back of the piston, and produce motion; and then, in effectually closing down and sealing the valve again, so as to leave the pipe in a fit state to receive the travelling piston of the next train, and ready to be again exhausted of its air.

Stationary engines of sufficient power, proportioned to the amount of traffic and speed required, would, in practice, be placed at intervals of about three miles apart, and be arranged to work the railway to that length, alternately on either side of their position, as might be required.

I have not attempted to go into a more detailed explanation of this simple mechanism, nor of the mode in which the main or pipe may be divided, by "separating, exit, and entrance valves," which do not offer any difficulty either in construction or use, into suitable and convenient lengths for exhaustion, in such manner as to allow the passage of the train, from one length into another, with any degree of velocity; these, and all the other minutiæ will be best

understood, by those who may be desirous of entering into them, from a visit to Wormwood Scrubs.

It may be sufficient here to observe, that the composition for sealing the valve has stood the effect of exposure to the seasons, and of continued use for nearly eighteen months:—that the tallow lining of the pipe, produces a smoothness over its interior, infinitely cheaper, and probably more effectual than the most finished boring; and that the connection of the piston in the pipe, with the train, will be readily comprehended by any one who will examine a pencil moving in an ordinary pencil-case.

When it becomes necessary to stop or retard the carriages, in addition to the use of a common break, a valve in the travelling piston may be opened by the guard or conductor of the train, whereby, the external air being admitted in advance of the piston into the exhausted portion of the pipe, the propelling power is at once destroyed.

The separating valves, in the main or pipe between each section or division of the line, being made self-acting, there will be no occasion for stopping, or even for retarding the movement of the train, in passing from one division of the pipe to another, as the air is successively exhausted by the stationary power,

placed at the proper intervals; the carriages may therefore pass continuously, at any required velocity, as if drawn by a Locomotive engine; and it is necessary to keep this circumstance in mind, as by any other system of traction by stationary engines, than the Atmospheric, a stoppage and a change at each engine is unavoidable.

All written descriptions of mechanical arrangements tend to produce, on the minds of those not well acquainted with such details, an impression of the existence of much greater complexity than is really found; one inspection, however, of the apparatus at Wormwood Scrubs, will convince any inquirer how extremely simple it is, and how very little liable to get out of order; that those parts which have a tendency to wear, can be easily and cheaply replaced, and that the comparison is strikingly favourable to the proposed system of working, as contrasted with the Locomotive engine; where all the complex details are crowded into the smallest possible space, where a considerable portion is necessarily exposed to the effects of an extremely high temperature, the several parts loaded with the strain of the whole force of the steam, moving with great rapidity among themselves, and where the whole machine generating the motion, is itself

impelled along with the mass at a high velocity.

The great feature of the modern system of Railway traffic, is this Locomotive steam-engine; and nothing is perhaps better calculated to demonstrate the mechanical genius of the country, than the successive improvements which have been applied in the details of its construction. While our engineers have gradually ventured to lay out Railways deviating greatly from the truly horizontal lines, originally considered nearly indispensable, and have increased the velocity of the trains to an extent almost alarming, the skill of the mechanist has kept pace with the necessity of finding powers to do the duty required: and by dint of strict regulation of the expenditure, and various minor improvements, the cost of Locomotive power has certainly decreased, when calculated upon a mere mileage of the trains. But as the gradients of Railways have been made steep, and as the rate of travelling has been augmented, the engines have, of necessity, been made of greater power and weight, and additional sources of danger created by the introduction of Assistant Locomotives, to surmount inclines, or to keep up high speeds, and by the necessary increased momentum of the trains.

With all the recent improvements and saving

in the cost of Locomotive power, the wear and tear, as compared with stationary power, is however fully 20 to 1; as may be exemplified in many instances of stationary engines, working 10 or 12 years without any material repairs, and scarcely without stopping; and contrasting this, with the costly establishments and constant expenditure incurred, even on short lines of Railway, in keeping up Locomotive engines to their effective performances.

In addition to the causes of damage and expense from the use of this travelling power, there are the delays incident to the slipping of the engine wheels, from the want of adhesion when the trains are heavy, or the gradient steep, or the rails "greasy" from slight rain, or glazed by fog or hoar frost, and again by the freezing of the pumps in severe wintry weather; each of which causes of delay becomes an additional source of danger, from which repeated and serious accidents, attended with fatal results, have happened. Although the occurrence of the pumps freezing is not frequent in this country, yet in many parts of northern Europe and America it must almost act as a total stoppage to Railway traffic, with Locomotive engines, in the depth of winter. The variation in the rate of travelling, from the varying velocities of trains drawn by Locomotive en-

gines, is likewise a cause from which accidents occur; and yet these different rates of speed can scarcely be avoided, as third class passengers and luggage, to be economically transported, must necessarily go by slower trains.

To these various disadvantages in working with Locomotive power, may be added the necessity of using *coke* almost exclusively, which, in remote districts particularly, adds enormously to the expense. Fixed engines, consuming coal or turf (and, on the continent of Europe and in America, wood), as the case may be, will give out steam power at a greatly less cost than Locomotives can do under the most favourable circumstances. But besides the wear and tear of the Locomotive engine, and its injurious effects on the Railway, there are some other striking disadvantages connected with it: a very considerable portion of its power is manifestly absorbed in moving its own weight and that of its tender; while it is equally obvious that the faster it travels, and the further the gradient deviates from a horizontal line, the more power is thus absorbed; but few persons are aware that this loss takes place in a rapidly increasing proportion, not only arising from the causes I have stated, but from others which are inherent in the construction of the machine: so much so, that it is stated by Mr. Wood, in the

last edition of his work on Railways, that under ordinary circumstances, increasing the velocity of a train from 25 to 30 miles per hour, is attended with a loss of more than half the effective power of the engine. A similar loss is sustained, if the Locomotive has to draw its load up an incline scarcely perceptible to the unpractised eye; and should this inclination be increased to 1 in 100, the effect is reduced to about one fourth of that produced on a horizontal plane, at the previous velocity; the power being lost or absorbed, in the inverse ratio in which it requires to be augmented, precisely at the moment when it is most important to obtain an increase. This subject has been ably treated in the Second Report of the Irish Railway Commissioners (see notes D and E, pp. 104 to 110, which are understood to be from the pen of Professor Barlow). It is there shewn that "the power thus absorbed, in what may be termed the *preparation for motion*, with first-class Locomotives, is, 1,075 lbs.; which is sufficient to draw more than 14 tons on a good road by horse power," "and, on a canal, with the usual barges," "more than 190 tons," and that "this absorbed power is nearly one-third of the whole power of the engine." Now, the great advantage of the Atmospheric system will be, to obviate the waste of power and consequent *absorption*

of profits, arising from transporting useless weight, and overcoming unnecessary friction, which it is hopeless to succeed in effecting by any other known mechanical means;* for, as it proposed to work on this system, there will be nearly obtained a corresponding dynamic effect for the amount of power generated, whatever it may be; whilst, by the present system, as I have already shewn, there is an enormous *absorption of power* by the Locomotive, whether moving at high rates of velocity, or up any material acclivities.

It is manifest that on Railways intended to be worked by Atmospheric power, there is not at all the same necessity for having "good gradients," as on those now at work; and where-

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* The Patentees have illustrated this by supposing, for the sake of argument, the expense of maintaining and working the London and Birmingham Railway to remain *unaltered*, but, by the adoption of some other mode of obtaining power, that the necessity of carrying the weight of the Locomotive engine and tender (20 tons) with each train was obviated, that weight being perfectly useless. It is clear that the Company would then be able to transport with each train, for the same cost as at present, 20 tons gross, say 15 tons net, of profitable merchandize additional, which (at the lowest charge for goods along the whole 112 miles, *viz.* £2 per ton), would add to the revenue £30 per journey, or with the present number of trains (12 in each direction every working day), about £225,000, a year, equal to an additional dividend of 5 per cent. to the Subscribers.

ever it may be necessary to adopt rather steep inclines, for some short distance, it can easily be accomplished, by increasing, *at the place of difficulty*, the dimensions of the apparatus and the amount of mechanical power.

If then, by the proposed means, steep rates of inclination may be overcome, without any further difficulty than that of supplying a proportionate increase of power, *at its proportionate cost*, it is clear that the savings in earth-work, bridging, road-approaches, rails, curves and other points of expense in construction, will follow of course; from the small height required for the carriages, the road may generally be so concealed, as to be very much less objectionable in comparatively private grounds; and various other sources of considerable expense may manifestly be obviated. Thus facilities will be afforded for the profitable introduction of Railways into districts which would be almost impermeable by the present means.

The economical advantages of the Atmospheric system, will be further exemplified in the diminution of the expense of maintenance. The destructive action of the Locomotive engine (seldom, with its compliment of water and fuel, of less weight than 15, and often nearer to 20 tons,) no longer impinging on the rails, a comparatively small sum will keep the line in

repair ; and though it may be difficult, beforehand, to assign the exact proportion of saving, it is evident the amount must be very considerable.

In the carrying department, the whole of the water stations, repairing shops, and fittings up, necessary for the Locomotive engines, are at once dispensed with, and the coverings and general arrangements of all stations much diminished in cost ; heavy turnplates may be wholly done away with, and even the smaller ones, except at the termini of great lines, as the carriages can move in either direction ; every description of carriage, having no longer to sustain the shock and tug of the Locomotive, may be made very much lighter and cheaper, and built to carry a greater useful load both of goods and passengers, in proportion to the weight, than is the case at present, and will last considerably longer.

The rate of travelling by the Atmospheric Railway, will depend on the rate at which the air in front of the piston may continue to be pumped out by the engine, a sufficient degree of exhaustion having been previously obtained to move the load at the required velocity ; and I see no reason to doubt that a speed of 60 miles per hour, may be easily, economically, and safely obtained by this means ; and, in addition, the passengers will be relieved from the noise, smell,

dust, sparks, and hot cinders from the Locomotive engine.

A moment's inspection of the apparatus, or a little consideration of the description, will be sufficient to produce the conviction, that the pressure of the atmosphere cannot move two trains at the same time in opposite directions, between any two stationary engines, and thus collision becomes impossible on the Atmospheric Railway. It is equally obvious, that one train cannot overtake another, and the leading carriage of each train being firmly attached to the piston-rod, it is scarcely possible that a carriage can be driven off the rails. Thus the ordinary sources of Railway accidents appear to me to be removed, and the apprehension of danger, now unfortunately so general, would soon naturally subside, on the introduction of this principle into practice.

It becomes manifest, from the preceding statements, that by the proposed means, *single* lines of Railway may be worked with perfect safety; there are but few districts of country through which, by starting trains with *sufficient* frequency, a single line of Railway would not be adequate for all their present or prospective traffic, even with the use of Locomotive engines; but single lines cannot be worked by these machines, without incurring that risk of col-

lision which will render the practice highly objectionable, and will always prevent the use of such lines to their full extent or capabilities.

The Atmospheric principle is free from this objection, and single lines can be worked thereby fully and effectively. Trains may be despatched from each end of any line, in *opposite* directions, as frequently as the traffic may demand, without the possibility of coming into collision; as it has been already shewn, that no trains in motion can possibly approach nearer to each other than one section of the main pipe, being at the least three miles. Sidings would of course be provided at every station.

In first construction, the economy will be very great, where the Railway shall be laid out originally to be worked on the Atmospheric principle; first, the saving on the longitudinal section, arising from the system of gradients which may now be adopted; next, the consequent saving in transverse section, further increased by the certain assurance that single lines may be almost universally introduced without any apprehension of danger; the cost may be likewise materially lessened, by introducing curves of much shorter radii than on ordinary Railways; the rails may be reduced to a weight little above a third of that now generally adopted,

and the expenditure on the remainder of the "upper works" be greatly economised. Nor is this all: where bridges or viaducts have to be built *over* roads, ravines, or rivers, to carry the Railway, very light and inexpensive structures may be substituted for the hitherto costly erections, in such cases necessary to sustain the weight and action of the Locomotive engines. And where the line has to pass *below* roads or canals, or through tunnels, the height of the arch may be made much lower than at present, eight feet in height, allowing sufficient space to clear the tops of the carriages; and in every place, this will form a vast economy, which will be well and readily appreciated by the engineer. A few sections and diagrams, illustrating the difference in some of the works necessary to be executed on the present, and on the proposed plan, will probably be sufficient to bring this part of the subject forcibly before your Lordship. Some of these illustrations, however, embrace extreme cases.

With stationary engines placed at intervals of, say three miles, there may be at those distances, under judicious management, a large amount of spare power to be employed for many useful purposes. At times, between the passing of the trains, when the engine would not be required to work the air-pump in exhausting

the pipe, it might grind oats or wheat, saw wood or stone, pump water, drain lands in one part, or irrigate them in another, thus performing various mechanical or agricultural operations. In suitable situations a smaller engine might be continually employed, in lieu of the larger one, in raising water to a proper reservoir, where it would be always ready and available, as the trains might arrive, being equally applicable as steam to work the air pump. All the contrivances for the economic generation and use of steam, such as clothing the boiler, and working by expansion, are available to the fullest extent with the stationary engine, which is not the case with the Locomotive. In some places, the natural supplies of water might even be accumulated in sufficient quantity to dispense with the steam engine altogether.

What the ultimate result would be of having a large amount of steam power,* which may be hired out on most reasonable terms for various useful purposes, spread over the face of the country at intervals of three miles, and having a Railway communication with each of them,

* In round numbers, upon the present and proposed Railway lines throughout the United Kingdom, this power would be equal in the aggregate to about that of 100,000 horses, and available for probably eight hours out of every twelve, should advantage be taken of it.

I shall not now stop to inquire; but I submit it as an interesting and peculiar feature of the proposed plan, and one eminently deserving your Lordship's attention.

As it is practicable, by the introduction of the Atmospheric system, to reduce the cost of constructing, maintaining, and working Railways so materially, a corresponding reduction in the charges for transmission of goods and passengers will follow; if, in addition, we are enabled to carry passengers at considerably greater speed and with much greater comfort, and, above all, if we are able to remove the apprehension of personal danger, who is there bold enough to assign the limit to the advantages of Railway intercourse by this means?

It may, perhaps, not be unnecessary to anticipate the very natural inquiry, why this invention, possessing all the advantages I have endeavoured to enumerate, has not yet been adopted by some of the enterprising parties engaged in Railway speculations, or to explain why the patentees themselves have not brought it out in a sphere of more extended operations.

The explanation is easy, and the answer to the inquiry simple. An experimental apparatus, in the hands and under the sole management of the patentees, will never satisfy the public; I submit, however, that they have already done

more than enough in demonstrating the principle and practice of their invention, to have induced spirited parties to have taken the matter up, were it not for the great amount of prejudice, arising chiefly from the abortive attempts of those who have hitherto trifled with this great principle of power. Independent of the extraordinary depression of speculative enterprise at the present moment, and which a variety of causes seems likely to retain in that state for some time to come, it is scarcely to be expected that those who are so deeply interested in the numerous Railways already constructed and in operation, whether as directors, shareholders, or engineers, should feel any desire to develope the capabilities of a new system, which may become the means of creating formidable rival lines. This will be better understood when I explain that, from causes which it is not now necessary to go into, the great direct line of Railways, connecting Liverpool and Manchester with the Metropolis, have alone involved an expenditure of nine millions sterling; and that the annual receipts are about one and a half millions, of which nearly fifty per cent. is absorbed in the expenses of working and maintenance.

The satisfactory solution, in the eyes of the public, of the Atmospheric system, reduced to

practical usefulness, could not be long without producing results, that would materially strike at the root of the monopoly which these great lines possess, and which has been often complained of.

It can be readily shewn that the same extent of Railways, connecting the above important places, might be made on the Atmospheric principle, at about one-third of the above cost; and, when completed, might be worked at nearly a proportionate reduction on the present gross charges; thereby ensuring a corresponding diminution of expenses to travellers, while affording, as has been explained, greater comfort, safety, and expedition.

However much, therefore, the public would benefit from the success of this invention, it is evident the numerous persons connected with Railway establishments, even if they were as thoroughly convinced as I am of the accuracy of what I now set forward, are the last persons to be expected to encourage the patentees, or to try the experiment.

Again, no Railway at full work could even make a trial of it, without most materially interfering with their existing traffic; and it may be doubted whether the funds of any company could, with strict legal propriety, be appropriated to the undertaking of such an experi-

ment except upon their own line. The conducting of any further inquiries, to test the merits, or to discover the practical disadvantages, if any exist, of the Atmospheric Railway, on which are to depend the adoption or rejection of this ingenious application, must therefore be undertaken by parties whose science, station, and character will, by an unbiased report, stamp that value on the invention which it ought to receive, should it be found to merit such approbation; and it is only from the Railway Department of the Board of Trade that the first steps to forward such an inquiry and report can emanate.

This, my Lord, is my statement; and I respectfully submit that I have established a case for further inquiry; to facilitate which, I am authorised by the patentees to state, that the present apparatus on the West London Railway, and the means of working and experimenting, shall be most unreservedly placed at the disposal of the Board of Trade and its officers; and that all drawings, specifications, calculations, and other information shall be furnished, which may be considered necessary to give proper and full explanations.

May I, therefore, beg your Lordship, in your official capacity as President of Her Majesty's Board of Trade and Plantations, to submit this

Letter to your Right Honourable Board, accompanied by my respectful but earnest request, that they may be pleased to refer it to such persons as their Lordships may select, to inquire into the several statements herein contained, and to report to your Lordships fully thereon, and particularly, whether this invention is entitled to a further and more extended trial, under suitable superintendence; and that your Lordships may also make such other and further orders in the premises, as the important interests herewith connected may appear to your Lordships to demand.

I have the honour to be,

My Lord,

Your Lordship's very faithful servant,

JAMES PIM, JUN.

Treasurer of the Dublin and Kingstown Railway Company.

Nuttall and Hodgson, Printers, Gough Square, London.

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